MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210 & TERM ID 2215)

EME1046 –Principles of Thermodynamics

(ME)

17 FEBRUARY 2023
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 4 pages including the cover page with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

A piston–cylinder device initially contains 0.8 m^3 of saturated water vapor at 250 kPa. At this state, the piston is resting on a set of stops, and the mass of the piston is such that a pressure of 300 kPa is required to move it. Heat is now slowly transferred to the steam until the volume doubles. Show the process on a P-v diagram with respect to saturation lines and determine

a) the final temperature,

(15 marks)

b) the work done during this process, and

(8 marks)

c) the total heat transfer.

(2 marks)

Question 2

A Carnot heat engine receives heat from a reservoir at 900°C at a rate of 800 kJ/min and rejects the waste heat to the ambient air at 27°C. The entire work output of the heat engine is used to drive a refrigerator that removes heat from the refrigerated space at -5°C and transfers it to the same ambient air at 27°C. Determine

a) the maximum thermal efficiency,

(3 marks)

b) the net power output,

(3 marks)

c) the coefficient of performance of the reversible refrigeration,

(3 marks)

d) the maximum rate of heat removal from the refrigerated space,

(4 marks)

e) the rate of heat removal from the heat engine,

(4 marks)

f) the rate of heat addition from the refrigerated space, and

(4 marks)

g) the total rate of heat rejection to the ambient air.

(4 marks)

Continued ...

Question 3

A hot-water stream at 80°C enters a mixing chamber with a mass flow rate of 0.5 kg/s where it is mixed with a stream of cold water at 20°C as shown in **Figure Q3**. Assume all the streams are at a pressure of 250 kPa. If it is desired that the mixture leave the chamber at 42°C.

a) Determine the enthalpy of hot-water stream,
(3 marks)

b) Determine the enthalpy of cold-water stream,
(3 marks)

c) Determine the enthalpy of mixture leave the chamber,
(3 marks)

d) Write a mass balance equation,
(4 marks)

e) Write an energy balance equation, and
(8 marks)

f) Calculate the mass flow rate of the cold-water stream.
(4 marks)

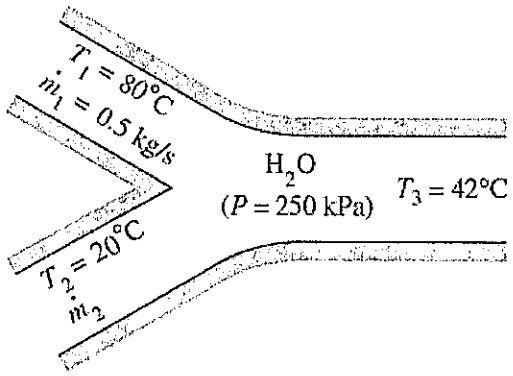

Figure Q3

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Question 4

A 0.5-m^3 rigid tank contains refrigerant-134a initially at 200 kPa and 40 percent quality. Heat is then transferred to the refrigerant from a source at 35°C until the pressure rises to 400 kPa. Determine

a) the initial internal energy, (2 marks)

b) the initial entropy, (2 marks)

c) the initial specific volume, (2 marks)

d) the final internal energy, (2 marks)

e) the final entropy, (2 marks)

f) the mass of the refrigerant, (3 marks)

g) the entropy change of the refrigerant, (3 marks)

h) the entropy change of the heat source, and (6 marks)

i) the total entropy change for this process. (3 marks)

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